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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/388,031	09/01/1999	SALMAN AKRAM	3442US(96-42	3303

7590 09/25/2002

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EXAMINER

LEE, EUGENE

ART UNIT

PAPER NUMBER

2815

DATE MAILED: 09/25/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/388,031

Applicant(s)

AKRAM, SALMAN

Examiner

Eugene Lee

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 10 June 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-28 and 100-129 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-28 and 100-129 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 01 September 1999 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

## **DETAILED ACTION**

### ***Drawings***

1. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description: element 62a. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

### ***Claim Rejections - 35 USC § 112***

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:  
  
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.
3. Claims 12 and 112 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 12 and 112 state the metal spacers extending along the sidewalls of the dielectric layer, however, in claim 1, applicant states that the metal spacers are substantially the same height as the sidewalls of the single conductive layer and metal layer. Since claim 12 is dependent on claim 1, the two claims are contradictory. The same rejection applies to claim 112, which is dependent on claim 102. Appropriate correction is required.

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***Claim Rejections - 35 USC § 102***

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 16 thru 20, 23 thru 25, 101, 116 thru 120, 123 thru 125 and 129 are rejected under 35 U.S.C. 102(e) as being anticipated by Lee et al. 5,534,463. Lee discloses (see, for example, FIG. 20) a wiring layer comprising a substrate 31, diffusion barrier layer (metal layer) 35, insulating layer (dielectric layer) 34, reactive spacer (metal spacer) 37a, and conductive layer (conductive layer) 39a. Regarding claim 17, see, for example, column 12, lines 26-35. Regarding claims 19, see, for example, column 12, lines 58-66.

***Claim Rejections - 35 USC § 103***

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 1, 4 thru 13, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Brennan et al. 6,074,943 in view of Liu et al. 6,277,745 B1. Brennan discloses (see, for example, FIG. 3) a interconnect structure comprising an underlying layer (substrate) 300, interconnect (single conducting layer) 310, and a thick buffer

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region (spacers). In column 1, lines 33-39, Brennan discloses that the thick buffer region may be metal. Brennan does not disclose a metal layer defining a pattern on a portion of the substrate upper surface. However, Liu shows (see, for example, FIG. 1D) an interconnect structure wherein a bottom barrier layer (metal layer) 4 lies underneath a copper interconnect layer 6. The bottom barrier layer passivates the underside of the overlying interconnect layer. See, for example, column 3, lines 34-38. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention to include the bottom barrier layer in Brennan in order to passivate the bottom surface of the interconnect 310.

Regarding claims 4 and 5, Liu states (see, for example, column 3, lines 38-42) that the bottom barrier layer may comprise TaN, TiN, Ta, or various single or stacked combinations.

Regarding claim 8, Brennan does not disclose the interconnect as copper or aluminum. However, Liu states (see, for example, column 1, lines 11-45) that copper is a material used for interconnects, which provides better circuit speed than aluminum. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to use copper in the interconnect material of Brennan in order to have good circuit speed and therefore minimize signal delays within a circuit.

Regarding claim 9, Brennan in view of Liu does not disclose the single conductive layer being an aluminum-copper alloy. However, it would have been obvious to one of ordinary skill in the art at the time of invention was made to use an aluminum-copper alloy, since aluminum-copper alloy has excellent conductive properties and it has been held to be within the general skill of a worker in the art to select a known material

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on the basis of its suitability for the intended use as a matter of obvious design choice. In re Leshin, 125 USPQ 416.

Regarding claims 10 and 11, Brennan does not disclose the metal spacers comprising at least one of Ti, Ta, W, Co, or Mo, or alloys thereof or compounds thereof, including TaN and TiN. However, Liu describes (see, for example, column 4, lines 24-29) an interconnect structure comprising protective spacers wherein the protective spacers may comprise Ta, TaN, TiN, or combinations thereof. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to use these materials in the metal spacers of Brennan in order to adequately protect the sidewalls of the interconnect structure.

Regarding claim 12, Brennan does not disclose the a dielectric layer on the conducting layer and having sidewalls aligned with said sidewalls of the single conducting layer, the metal spacers extending along the sidewalls of the dielectric layer. However, Liu teaches (see, for example, column 5, lines 1-17) an insulating layer (dielectric layer) 16 that insulates the top surface of the interconnect structure. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to include the insulating layer of Liu in Brennan in order to insulate and protect the top of the interconnect structure.

8. Claims 2, 3, 100, 102 thru 113 and 115 are rejected under 35 U.S.C. 103(a) as being unpatentable over Brennan et al. '943 in view of Liu et al. '745 as applied to claims 1, 4 thru 13, and 15 above, and further in view of Cox 6,166,439. Brennan in view of Liu does not disclose a dielectric layer on the substrate upper surface and underlying the metal layer. However, Cox discloses (see, for example, Fig. 2) a semiconductor device

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comprising conductive lines 54, 56, and 58 over an insulating layer 50a and substrate 50b. The insulating layer serves as a base upon which the conductive pattern is constructed. See column 5, lines 1-7. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to include the insulating layer in order to provide a further base for the semiconductor device.

Regarding claims 3 and 103, Brennan in view of Liu in view of Cox does not disclose the dielectric layer being silicon oxide or BPSG. However, it would have been obvious to one of ordinary skill in the art at the time of invention was made to use silicon oxide or BPSG, since silicon oxide and BPSG provide strong insulative properties and it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. In re Leshin, 125 USPQ 416.

Regarding claim 109, Brennan in view of Liu in view of Cox does not disclose the single conductive layer being an aluminum-copper alloy. However, it would have been obvious to one of ordinary skill in the art at the time of invention was made to use an aluminum-copper alloy, since aluminum-copper alloy has excellent conductive properties and it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. In re Leshin, 125 USPQ 416.

9. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Brennan et al. '943 in view of Liu et al. '745 as applied to claims 1, 4 thru 13, and 15 above, and further in view of Matsuno 6,046,502. Brennan in view of Liu does not disclose a fluorine-doped silicon oxide. However, Matsuno teaches that dielectric films doped with

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fluorine provide films with low dielectric constants. See, for example, see column 1, lines 20-63. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to add fluorine, in order to form a low dielectric film, and improve the overall speed of a semiconductor device.

10. Claims 26 thru 28 and 126 thru 128 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al '463 as applied to claims 16 thru 20, 23 thru 25, 101, 116 thru 120, 123 thru 125 and 129 above, and further in view of Drynan 6,197,682 B1. Lee does not disclose one upper metal layer on the conductive layer and comprising Ti, Ta, W, Co, or Mo or an alloy or a compound of any thereof, including TaN or TiN. However, Drynan shows (see, for example, FIG. 26B) a semiconductor device comprising a third wiring layer (upper metal layer) 338a on top of a first contact plug 337a. The third wiring layer allows for more interconnections in the semiconductor device. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to include an upper metal layer in order to have more wiring interconnections within the device.

11. Claims 21, 22, 121, and 122 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. '463 as applied to claims 16 thru 20, 23 thru 25, 101, 116 thru 120, 123 thru 125 and 129 above, and further in view of Cox '439. Lee does not disclose the substrate comprising a dielectric layer underlying the metal layer. However, Cox discloses (see, for example, Fig. 2) a semiconductor device comprising conductive lines 54, 56, and 58 over an insulating layer 50a and substrate 50b. The insulating layer serves as a base upon which the conductive pattern is constructed. See column 5, lines 1-7. The insulating layer also provides suitable separation between the overlying



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semiconductor device and the substrate. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to include the insulating layer on the substrate of Liu for the reasons cited above.

12. Claim 114 is rejected under 35 U.S.C. 103(a) as being unpatentable over Brennan et al. '943 in view of Liu et al. '745 in view of Cox '439 as applied to claims 2, 3, 100, 102 thru 113 and 115 above, and further in view of Matsuno '502. Brennan in view of Liu in view of Cox does not disclose a fluorine-doped silicon oxide. However, Matsuno teaches that dielectric films doped with fluorine provide films with low dielectric constants. See, for example, see column 1, lines 20-63. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to add fluorine, in order to form a low dielectric film, and improve the overall speed of a semiconductor device.

### *Response to Arguments*

13. Applicant's arguments with respect to claims 1-28, and 100-129 have been considered but are moot in view of the new ground(s) of rejection.

### *Conclusion*

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within

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TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

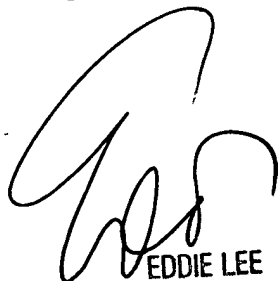
### **INFORMATION ON HOW TO CONTACT THE USPTO**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eugene Lee whose telephone number is 703-305-5695. The examiner can normally be reached on M-F 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C. Lee can be reached on 703-308-1690. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Eugene Lee  
September 19, 2002



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